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A HOST PLANT LIST OF APHIDS IN THE VICINITY OF THE UNIVERSITY OF FLORIDA [1]

By Arthur C. Mason

Our present literature on the insect life of Florida contains very few references to aphids. In fact, only a few species which are of economic importance are even mentioned, and nothing like a list of those occurring in the State has been attempted. While this paper does not contain a complete list of the plant lice of Florida or even this section of the State, still it may serve as a start toward such a list, and may be added to from time to time.

Previous references include *Aphis brassica* on cabbage (31) (32), *Myzus persicae* on peach and tomatoes (26) (36), *Megoura solani* on tomatoes (35) (36), *Aphis gossypii* on cotton, cucurbits, and orange (2) (22) (31) (32), *Siphonophora cucurbitae* on egg-plant (32), *Aphis maidis* on corn (1), and *Toxoptera graminum* on oats (37). These are dealt with purely from an economic standpoint.

Lists of aphids have been written by several entomologists for various sections of the country, but none of them cover Florida. While it is true that a large number of plant lice are widely distributed and found in practically all the states, some others may be restricted to this part of the country alone. Therefore, a complete list for this State should be prepared.

The insects listed were collected over a period of two years

[1] Taken from thesis entitled "Systematic and Biological Studies of Some Florida Aphididae," presented by the writer to the University of Florida in 1915 for the degree of Master of Science.
This paper constitutes Part I exclusive of sections on methods of collecting, mounting, etc. Parts II and III together with references cited will appear in later issues.

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(1913-1915) and during all seasons. They represent those found on both cultivated crops and wild plants. The former, of course, are brought to the attention of economic workers much more often because of their importance to agriculture and also their greater abundance. The list represents about 30 species of aphids. Many others collected could not be determined because of lack of mature specimens or winged forms. Undoubtedly there are in the state many undescribed species of plant lice and at least two of these were found.

Permanent mounts were made of all specimens and are in the author's collection. Natural colors cannot be retained in mounted slides and color notes must be made from the live specimens.

HOST PLANT LIST OF APHIDS[1]

Ampelopsis quinquefolia (Virginia creeper)	
	Aphis folsomii Davis
Andropogon sorghum var. (sorghum)	
	Sipha flava Forbes.
Apple—see *Pyrus malus*	
Avena sativa (oats)	*Aphis avena* Fitch
	Macrosiphum granaria Buckt.
	Myzus persicae Sulz.
	Toxoptera graminum Rond.
Bean—see *Phaesolus vulgaris*	
Beet—see *Beta vulgaris*	
Beta vulgaris (beet)	*Myzus persicae* Sulz.
Brassica oleraceae (cabbage)	*Aphis brassicae* L.
	Aphis pseudobrassicae Paddock
	Myzus persicae Sulz.
Brassica oleraceae var. *acephala* (collards)	
	Aphis pseudobrassicae
	Myzus persicae Sulz.
Brassica oleraceae var. *acephala* (kale)	
	Myzus persicae Sulz.
Brassica oleraceae var. *botrytis* (cauliflower)	
	Myzus persicae Sulz.
B. oleraceae var. *caulo-rapa* (kohl rabi)	
	Myzus persicae Sulz.
Brassica rapa (turnip)	*Myzus persicae* Sulz.
Cabbage—see *Brassica oleraceae*	
Calabash gourd—see *Lagenaria vulgaris*	
Capsicum annum (pepper)	*Myzus persicae* Sulz.
Carrot—see *Daucus carota*	
Cauliflower—see *Brassica oleraceae* var. *botrytis*	
Chenopodium viride (Lamb's quarters)	
	Myzus persicae Sulz.

[1] Credit for the determinations of many of the aphids listed herein is given to J. J. Davis, Edith M. Patch, and F. B. Paddock.

Chloris gavana (Rhodes grass)	*Macrosiphum sp.*
	Sipha flava Forbes
Chrysanthemum sp. (Chrysanthemum)	
	Macrosiphum sanborni Gill.
Citrullus vulgaris (watermelon)	*Aphis gossypii* Glov.
Citrus aurantium (orange)	*Aphis gossypii* Glov.
	Myzus persicae Sulz.
	Toxoptera aurantii Koch.
Collards—see *Brassica oleraceae* var.	*acephala*
Corn—see *Zea Mays*	
Cotton—see *Gossypium herbaceum*	
Cucumis sativus (cucumber)	*Aphis gossypii* Glov.
Cucumis sp. (musk-melon)	*Aphis gossypii* Glov.
Cucurbita sp. (squash)	*Aphis gossypii* Glov.
Cyperus esculenta (nut grass)	*Carolinaia sp.*
	Sipha flava Forbes.
Daucus carota (carrot)	*Myzus persicae* Sulz.
Easter lily—see *Lillium longiflorum*	
Egg-plant—see *Solanum melongena*	
English ivy—see *Hedera helix*	
Euphorbia pulcherrima (poinsettia)	*Myzus persicae* Sulz.
Gnaphalium spathulatum	*Aphis gossypii Glov.*
	Macrosiphum rudbeckiae Fitch.
	Myzus persicae Sulz.
Gossypium herbaceum (cotton)	*Aphis gossypii* (Reported in Bul. 34, Fla.)
Grape—see *Vitis sp.*	
Grasses	
Andropogon annulatus	
Andropogon barbindoes	
Andropogon halepensis (Johnson grass)	
Andropogon monticela	
Andropogon sericens	
Andropogon sp. (Soudan grass)	
Anthephora hermaphrodita	
Cenchus biflorus	
Chaetochloa flava	
Chaetochloa aurea	
Eleusine coracana	
Eragrostis eurouloa	
Eulalia japonica zebrina	
Melinis multiflora	
Panicum antidoldes	
Panicum maximum	
Panicum hirsutissimum	
Paspalum nodosum	
Paspalum stoleniferum	
Pennisetum glaucum	
Pennisetum spicatum	
Pennisetum typhoideum	

Sorghastrum stipoides	
Syntherisma consanguinea	
Tricholaena rosea (Natal grass)	
Tricholaena wrightii	
	Sipha flava Forbes
Green briar—see *Smilax sp.*	
Hedera helix (English ivy)	*Aphis hederae* Kaltenbach.
	Myzus persicae Sulz.
Helianthus annuus (sunflower)	*Myzus persicae* Sulz.
Hickoria alba	*Phylloxera caryae-scissa* (Reported by Pergande (30)
Hickoria pecan (pecan)	*Phylloxera sp.*
Hickoria sp. (hickory)	*Monellia caryella* Fitch.
	Phylloxera sp.
	Phylloxera sp.
	Phylloxera sp.
Holly—see *Ilex opaca*	
Hybiscus esculentus (okra)	*Myzus persicae* Sulz.
Hybiscus sp. (hybiscus)	*Myzus persicae* Sulz.
Ilex opaca (holly)	*Toxoptera aurantiae* Koch.
Ipomoea pandurata (moonflower)	*Aphis gossypii* Glov.
Ironweed—see *Vernonia angustifolia*	
Kale—see *Brassica oleraceae* var. *acephala*	
Kohl rabi—see *Brassica oleraceae* var. *caulo-rapa*	
Lactuca sativa (lettuce)	*Macrosiphum rudbeckia* Fitch
	Myzus persicae Sulz.
Lagenaria vulgaris (calabash gourd)	*Aphis gossypii* Glov.
Lamb's quarters—see *Chenopodium viride*	
Lettuce—see *Lactuca sativa*	
Lillium longiflorum (Easter lily)	*Aphis gossypii* Glov.
	Myzus persicae Sulz.
Lycopersicum esculentum (tomato)	*Megoura solani* Thomas (Reported Fla. Bul. 125)
	Myzus persicae Sulz.
Moonflower—see *Ipomoea pandurata*	
Musk-melon—see *Cucumis sp.*	
Mustard, black—see *Sinapis nigra*	
Nut grass—see *Cyperus esculenta*	
Oats—see *Avena sativa*	
Okra—see *Hybiscus esculentus*	
Orange—see *Citrus aurantium*	
Pansy—see *Viola tricolor*	
Parsnip—see *Pastinaca sativa*	
Pastinaca sativa (parsnip)	*Myzus persicae* Sulz.
Pea—see *Pisum sativum*	
Peach—see *Prunus persica*	
Pecan—see *Hickoria pecan*	
Pepper—see *Capsicum annum*	
Phaesolus vulgaris (garden bean)	*Myzus persicae* Sulz.
Pine—see *Pinus taeda*	

Pinus taeda (pine)	*Lachnus pini* L.
Pisum sativum (garden pea)	*Macrosiphum pisi* L.
	Myzus persicae Sulz.
Poinsettia—see *Euphorbia pulcherrima*	
Potato—see *Solanum tuberosum*	
Prunus persica (peach)	*Myzus persicae* Sulz.
Pyrus malus (apple)	*Aphis pomi* DeG.
Radish—see *Raphanus sativus*	
Raphanus sativus (radish)	*Myzus persicae* Sulz.
Rhodes grass—see *Chloris gavana*	
Rosa sp. (rose)	*Macrosiphum davisi* Del G.
Rose—see *Rosa sp.*	
Saccharum officinarum (sugar cane)	*Sipha flava* Forbes
Sinapis nigra (black mustard)	*Myzus persicae* Sulz.
Smilax sp. (green briar)	*Pemphigus attenuatus* Osb.
Solanum melongena (egg-plant)	*Myzus persicae* Sulz.
	Siphonophora curcurbitae Middleton. (Reported from Bul. 34, Fla.)
Solanum tuberosum (potato)	*Myzus persicae* Sulz.
Sonchus asper (spiny-leaved sonchus)	*Rhopalosiphum sonchi* Oestlund.
Sonchus oleraceus (sow thistle)	*Rhopalosiphum sonchi* Oestlund.
Sophia pinnata (Tansy mustard)	*Myzus persicae* Sulz.
Sorghum—see *Andropogon sorghum*	
Sow thistle—see *Sonchus oleraceus*	
Squash—see *Cucurbita sp.*	
Stizolobium deeringianum (velvet bean)	*Myzus persicae* Sulz.
Sugar cane—see *Saccharum officinarum*	
Sunflower—see *Helianthus annuus*	
Tansy mustard—see *Sophia pinnata*	
Tomato—see *Lycopersicum esculentum*	
Turnip—see *Brassica rapa*	
Velvet bean—see *Stizolobium deeringianum*	
Vernonia angustifolia (Ironweed)	*Aphis vernoniae* Thos.
Viola tricolor (pansy)	*Myzus persicae* Sulz.
Viola sp. (violet)	*Myzus persicae* Sulz.
Violet—see *Viola sp.*	
Virginia creeper—see *Ampelopsis quinquefolia*	
Vitis sp. (wild grape)	*Macrosiphum viticola* Thos.
Watermelon—see *Citrullus vulgaris*	
Zea Mays (corn)	*Aphis maidis* Fitch (Reported in Fla. Bul. 2)
	Aphis setariae Thos.
	Macrosiphum sp.
	Myzus persicae Sulz.
	Sipha flava Forbes.
	Toxoptera graminum Rond.

MINUTES OF MEETINGS

LANGUAGE HALL, April 25, 1921.

Society called to order 4:30 p. m. President Watson in the chair. The paper of the evening was "Fungus Enemies of the Walnut Aphis," by Dr. O. F. Burger. The paper was very interesting and highly appreciated by all present.

Under Timely Notes, Dr. Montgomery stated that the Pink Boll Worm had been found on four islands of the West Indies.

Mr. Stirling spoke of a new insect that had been reported as doing considerable damage to cotton in Mexico.

J. Chaffin reported considerable damage being caused by orange leaf notcher *(Artipus floridanus)* and Blue Green Citrus Beetle *(Pachnaeus opalus)* to citrus and avocado in vicinity of Little River.

There being no further business, the society adjourned.

J. CHAFFIN, *Secretary.*

DEFERRED MEETING OF JULY 11, 1921

Meeting was called to order at 4:45 by Prof. J. R. Watson, the president, in the chair. Mr. Chamberlain, in charge tobacco insect investigations for the Bur. Ent., U. S. D. A., at Quincy, Fla., was elected to membership.

Prof. Fattig, the vice president of the Society, having left the State permanently, this office was declared vacant by a vote of the Society, and Mr. A. C. Brown elected by acclamation to fill this vacancy.

It was voted to omit the regular July and August meetings and have the next meeting in September.

There were present: J. R. Watson, Geo. B. Merrill, A. H. Beyer, A. C. Brown, J. C. Goodwin, J. H. Montgomery, F. M. O'Byrne, and E. W. Berger.

The paper of the evening was by Mr. A. H. Beyer, Asst. Entomologist at Experiment Station. Subject: *Coccobacillus acridiorum* as a Factor in Locust Control. Mr. Beyer's paper consisted of a discussion of his work on this bacterium while he was in the employ of the U. S. D. A. in 1919. The paper was of great interest and a brief resume by the author is attached to these minutes.

Under Brief and Timely Notes Prof. Watson showed a bagworm and also a large thrips.

The Society adjourned at 6 p. m.

E. W. BERGER, *Secretary pro-tem.*

October 5, 1921.

A special meeting and smoker of the Florida Entomological Society was called to order at 8:30 p. m., President Watson in the chair. Members present: Berger, Briggs, Brown, Burger, Chaffin, DeBusk, Goodwin, Hunt, Merrill, Mason, Newell, Montgomery, Reese and Yothers. Several visitors and speakers of the Citrus Seminar were also present.

The president welcomed the visitors and made a few introductory remarks, after which business was taken up in the regular order. On motion and second E. L. Lord, Assistant Professor of Horticulture in the Agricultural College, was duly elected a member of the society.

Mr. W. W. Yothers of the Bureau of Entomology was called on for a few remarks and he gave a very interesting account of some of the work and experiments he is carrying on at Orlando in the control of citrus insect pests. He spoke of the difficulty of rearing rust mites in confinement and of controlling the Fla. Red Scale *(Chrysomphalus aonidum)*. He stated that he had found a 2% emulsion of a heavy viscid oil satisfactory.

Dr. H. A. Morgan, president of the University of Tennessee, was then called upon. He gave a very humorous and interesting talk on his experiences as an Entomologist in Louisiana twenty or thirty years ago. He also gave a brief account of his work in distributing a parasite of the Harlequin Cabbage bug and his efforts in helping secure the first Government appropriation for the eradication of the cattle tick.

Mr. Neal F. Howard of the Bureau of Entomology next gave some interesting facts in regard to the Mexican bean beetle situation in Alabama and Georgia.

On motion of Dr. J. H. Montgomery, the Society passed the following resolution:

"Whereas, the attention of the Society has been directed to work done by Dr. A. T. Speare of the Bureau of Entomology in connection with fungi preying upon mealybugs and rust mites, and

"Whereas, the results so far obtained are extremely promising and indicate that a natural control of these pests may be found to be of practical value, and

"Whereas, in the opinion of the Society, this work should be prosecuted vigorously and without interruption,

"Therefore, Be it resolved by the Florida Entomological So-

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The

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PROFESSOR J. R. WATSON.....*Editor*
DR. WILMON NEWELL.....*Associate Editor*
DR. E. W. BERGER.....*Business Manager*

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ENTOMOLOGICAL PAPERS AT THE CITRUS SEMINAR

On Oct. 5 Mr. W. W. Yothers read a paper on "Some Fundamentals of Grove Pest Control." He stated that there are three possible viewpoints: (1) To do nothing, leaving the control of the pests to their natural enemies. (2) To take such measures as will reduce their numbers to the point of commercial control. This will necessitate frequent repetitions of the control measures. (3) To eradicate the pest—expensive in the first costs but perhaps often cheapest in the end. Which method should be pursued will depend upon the insect. Or a combination of the methods will often be most practical.

Mr. Yothers also read a very valuable paper by Dr. A. T. Speare of the U. S. Bur. of Ent., founded on work done in Mr. Yothers' laboratory at Orlando. It has long been a matter of common observation that the citrus rust mites and mealy bugs tend to disappear with the advent of the rainy season. It has been generally supposed that this was due to their being washed off by the heavy rains. But according to Dr. Speare the true cause is the rapid development of two fungi under the influence of the high humidity of the rainy season. The fungus which infects the rust mites is a species of *Cordiceps*. Infected rust mites may be recognized by their shrunken appearance and of course absence of movement. The fungus which attacks the mealy bugs is an undescribed species of *Entomophora*. Infested mealy bugs may be recognized by their soft spongy texture. Under a sharp knife they can be cut like cheese.

These discoveries are not only of great scientific interest but of equal practical importance. If a grower finds that one of these fungi is rapidly developing in his grove, under suitable

weather conditions he may often safely leave the control of the pest to the fungus, and save the cost of spraying.

Another paper on entomogenous fungi was read by Dr. E. W. Berger, who gave a brief account of his growing, in pure cultures, of two fungi hitherto not so grown and of his discovery of a new strain of the Red Whitefly-Fungus.

The new fungi are *Aschersonia goldiana* on Cloudy-winged Whitefly from Cuba (specimens received at the Experiment Station) and on an unknown aleyrodid from Winter Park, Florida; and the Cuban Aschersonia found infecting the Pyriform Scale, and Liriodendron Scale in Florida, and the Tessellated Scale in Porto Rico.

The new strain of the Red Whitefly-Fungus was discovered on some holly and bay leaves sent in from a hammock at Winter Park, Fla. It fruits freely in the culture bottles during summer, a fact which has not been true for the other strains heretofore grown. This fact will make it possible to grow it in smaller quantities during summer as needed, thus always assuring a fresher product than heretofore when the whole crop had to be grown in late winter and early spring and kept in cold storage. Indications are that it is also an unusually virile strain.

Prof. J. R. Watson presented the results of some recent experiments on spraying for thrips. He exhibited a table giving the results of spraying to lessen thrip marks on fruit. This covered the results in seven groves from Lake to St. Lucie counties. In groves where the thrips averaged from 25 to 64 per bloom, about half of the unsprayed fruit was marked to such an extent as to lower its grade from brights to goldens if otherwise perfect. 38% of this scarring was prevented by a single spraying. This repaid the cost of spraying many times over. Groves in which the thrips averaged 10 per bloom did not repay the cost of spraying for thrips alone. But where they were being sprayed at blossoming time for rust mite or scab the additional cost of adding ¾ pt. of Black Leaf 40 per 100 gallons was repaid twice over.

The proper time to spray is when the trees are in full bloom, and the proper solution at least 1 pt. of Black Leaf 40 to 100 gallons of the rust mite spray solution.

Mr. Neal F. Howard gave an interesting account of the Mexican Bean Beetle investigations of the Bur. of Entomology, U. S. D. A., in Alabama, Georgia and Tennessee. There appears to be no hope of stopping the beetles and growers of legumes will have

to plan substituting other crops and immune species. Fortunately, the velvet bean, both bush varieties and climber, are immune, except that the adult beetles do feed some upon them, so that this bean may have to be substituted as a cover crop and forage in place of cow peas and beggar weed. Snap beans appear doomed. The use of poisons in its control have proved unsatisfactory. Investigations in Mexico, in search of natural enemies, have so far been fruitless.

Mr. Chaffin read a paper on mealy bugs. This is printed elsewhere in this journal.

MINUTES OF MEETINGS

(Continued from page 27)

ciety, in special session at Gainesville October 5, 1921, that Dr. Speare be congratulated upon the success which has so far attended his efforts, and

"Further, That the Secretary of the Society communicate with the Chief of Bureau of Entomology expressing the hope of the Society that Dr. Speare will be assigned to further investigational work in Florida to the end that this work be completed."

There being no further business, the Society adjourned.

J. CHAFFIN, *Secretary.*

PERSONALS

Among our out of town members present at the Citrus Seminar were W. W. Yothers and A. C. Mason of the U. S. Ent. Lab. at Orlando; E. F. DeBusk, County Agent of Lake; W. R. Briggs, Agent for Manatee County; Mr. Seth Walker of the Citrus Exchange; Mr. K. E. Bragdon, formerly County Agent of Brevard but now Field Agent with the Citrus Exchange Supply Co.; and Mr. C. M. Hunt, Assistant Nursery Inspector.

Miss Evelyn Osborn, formerly Assistant in Entomology in the Experiment Station, was on Aug. 27 married to Mr. Chas. M. Knapp of Syracuse, N. Y.

Prof. Carl J. Drake received the degree of Ph. D. from Ohio State University in June. He has been spending the summer in Mississippi, Arizona, and California.

W. S. Blatchley received the degree of LL. D. from the University of Indiana in June. Dr. Blatchley is one of less than a dozen to receive this degree from Indiana University. He expects to return to his winter home in Dunedin shortly.

The stork has recently visited the homes of two of our members, Mr. Geo. Merrill and Mr. W. W. Yothers. Both girls.

Mr. P. W. Fattig is now teaching biology in the State Normal School at Farmville, Va.

MEALYBUGS

By JEFF CHAFIN

Mealybugs are one of the most widely distributed group of insects known; they occur in practically every country in the world and attack nearly every cultivated and wild plant. If it were not for the fact that they have a large number of natural enemies they would no doubt do serious damage to many of our most valuable crops. They seem to thrive best and do the most damage in tropical and subtropical climates. We probably have forty or fifty different species in this State, but of that number there are only three or four that do very much damage. However, many of the most injurious species have not been introduced into Florida.

One species that we do not have does serious damage to sugar cane in Cuba. California has two species that do considerable damage: Baker's mealybug which attacks the grape, and the citrophilus mealybug which prefers citrus. They have made several unsuccessful efforts to control and eradicate these pests. These two species are probably the most injurious mealybugs in the United States and neither of them is present in Florida at the present time. There are no doubt many other species in the United States, as well as in the tropical countries, that would do serious damage if brought to this State.

The mealybug that does the most damage in Florida at the present time is the Common Citrus Mealybug *(Pseudococcus citri)* which is a serious pest in our ornamental nurseries and greenhouses and sometimes becomes very numerous in citrus groves during dry seasons. During the dry spell last summer they did more damage than usual all over the citrus belt. This particular species is present all over the United States but it seems to do the most damage here. We do not hear of it causing any damage in California, so either their climatic conditions are unfavorable for it or they have some natural enemy that we do not have.

The next of importance is the Cocoanut Mealybug *(P. nipae)* which is always present on trees and ornamentals in the southern part of this State. During the dry spell last summer the

avocados, mangoes, sapodillas, palms, many other ornamental plants in Fort Myers were covered with this insect. The sooty mold, growing on the honey dew excreted by the pest, made a very unsightly appearance and, of course, the fruit and plants were damaged. This species apparently does not have as many natural enemies as the common citrus mealybug and is just as hard if not harder to control.

Another species that is beginning to play an important part is the Pineapple Mealybug *(P. bromeliae)* which did quite a bit of damage to several pineapple plantings down the east coast this year. This pest prefers the pineapple and was probably brought to this State several years ago on imported pineapple slips.

The life cycle of a mealybug is short and a female will lay from three to five hundred eggs; so if conditions are favorable it takes only a short time for them to become very numerous regardless of the fact that they have a large number of natural enemies. They have insect friends that protect them and aid in their multiplication. Several species of ants will carry the young mealybugs around and protect them in order that they may secure the honeydew secreted by the pest. The most active ant along this line is the Argentine ant, which we do not have in this State at the present time.

Owing to the large number of host plants, rotation of crops would do very little good in the control of mealybugs. Some of the most important natural enemies are some hymenopterous parasites, lady beetles and the larvae of syrphid and lace-wing flies.

Mealybugs are covered with a wax-like secretion and the eggs are deposited in a mass of this material, so spraying with a strong insecticide has very little effect. When the rainy season begins, the severe infestations disappear, so spraying with clear water under high pressure to wash the insects from the tree has been recommended by the best Entomologists for years, but anyone who has had much experience spraying for mealybugs knows that any kind of solution or pressure gives very poor results.

Quite recently one of the field men of the Bureau of Entomology discovered an unnoticeable fungus attacking the mealybug and when the rainy season began this year this fungus completely destroyed the severe infestations in several groves that he had under observation. Personally, I believe their disappearance during rainy weather is due to this fungus rather than the

rain. If this is the case, our problem is to induce this fungus to thrive during dry weather or find some parasite that will hold the mealybug in check until the rainy season begins.

IT PAYS TO CONTROL RUST MITE

J. G. GROSSENBACHER

Strange to say, the rust mite is not an insect but is more closely related to spiders. It is a near kin of the itch mite, "red bugs," red spiders, and cattle ticks. It feeds on all new green growth of trees: leaves, fruit and twigs. It seems to live on juices taken from trees, particularly the oil. However, if these mites consumed all the oil from the glands they open we would have no real rusty fruit. In fact, the rusty appearance of fruit, leaves and twigs is due to the oil oozing from glands that had been tapped by the mites. The oil flowing from the punctured glands spreads out more or less over the rind of the fruit and during nights of heavy dew or light showers may run down the sides of the fruit in narrow bands; the exposure of these thin layers of oil to the air causes the oil to break down or oxidize and change to a dark color, thus resulting in rust and where it had run down the fruit in streaks to "tearstaining."

There is another effect that the exuding oil has on young fruit and other newly developed parts of trees that should be mentioned in this connection. In 1914 and 1915, I punctured a large number of oil glands on newly hardened young twigs and half-grown oranges with a very fine pointed needle under a lens. The punctured areas were marked and kept under observation during some weeks. Small amounts of oil escaped from each pricked oil sack and spread over tiny spots and areas, the shape of which depended upon the action of gravity on the escaping oil. After a few days the distribution of the oil was definitely and clearly shown by brown spots of the exact size and shape of the oil-covered area. In order to make a further test of the effects of orange oil on the epidermal tissues of fruit, leaves and twigs of orange and grapefruit, a small quantity of this oil was obtained and applied with an atomizer so as to cover the surface with tiny spots of oil; in other cases the application was continued until the oil spots became so numerous and close together that they eventually touched and thus covered considerable areas completely with a continuous film of orange oil. The result was interesting in that in case of the light applications every point, formerly occupied by oil-dust particles delivered by

the atomizer, was shown by a tiny brown spot. Where the applications had been so heavy that considerable areas were covered with a continuous film, these areas showed up of the same size and shape as brown blotches. On closer examination the outer skin of these oil covered spots was found to have been killed, leaving a rough outer surface consisting of broken, dead skin tissue adhering to an imperfect substitution skin underneath. In a few cases of extra heavy application of orange oil the entire bark was killed to the wood on twigs as large as a lead pencil, thus resulting in the death of the twigs.

In making these tests with needle pricks and atomizer, I was trying out a suspicion that melanose and ammoniation spots may be due to the bursting of oil glands and the consequent exudation of their contents to the outer surface where the effect of the oil would damage the epidermal layer or outer skin of newly grown leaves, fruit, and twigs. It is evident that the oil is a factor in the development of melanose and ammoniation or dieback spots but the reasons for the escape of the oil from the sacks to the outside must be found before a full explanation can be given. In case of the disease known as melanose it appears that probably abortive infections from spores of the stem-end-rot fungus permit the leakage of the oil and thus result in melanose spots.

Coming back now to the appearance we call rust, one need only examine a very rusty orange that had an early infection, with a hand lens, to see that the outer skin has been killed and that its broken fragments are adhering to an imperfect inner one. This is true only of russeting that is due to an early attack of rust mites on fruit. In case rust mite does not become very numerous until after the fruit has attained considerable size, however, the oil injury following is not so serious and usually gives rise to smooth russets. The rough russets due to the early attacks of rust mites are commonly called buck-skin or shark-skin fruits.

The effects, then, of rust mite on fruit are considerable and various, depending upon the relative earliness and intensity of the infestation and on the weather conditions prevailing during the period of greatest activity. For example, tear-staining can probably result only during periods of comparatively dry weather so that the exuded oil accumulating in spots of intense mite activity may be carried down the sides of fruit in streaks by dew deposits thus allowing concentrated action of the oil, while

rains probably dilute the oil to such a degree and wash it off so quickly that no discoloration can result in streaks. Again, a comparatively late attack of the mite will result only in smooth russets and practically no buck-skin effects. In any case, however, it is evident to everyone who observes the presence and activities of the enormous numbers of mites on heavily infested trees that the devitalizing effects of this pest on trees must be more in proportion to their numbers than to their size.

The immediate and most striking loss to growers due to the unhindered development of rust mites in bearing groves is of two kinds: the discoloration of the rind of fruit, and stunting effect on the fruit growth occasioned by the injuries on the rind. The devitalizing effects on trees necessarily also affects fruit size but probably tells heavier on the performance of trees the following season.

(Excerpt from Citrus Leaf No. 7, published May 1, 1921, by the Florida Insecticide Company, Apopka, Florida.)

The negro caretaker of the Reid Bryan nursery reports that he has sprayed every month with "miserable oil." Some of it is, we'll say!

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